Calibration certificate

Density calibration

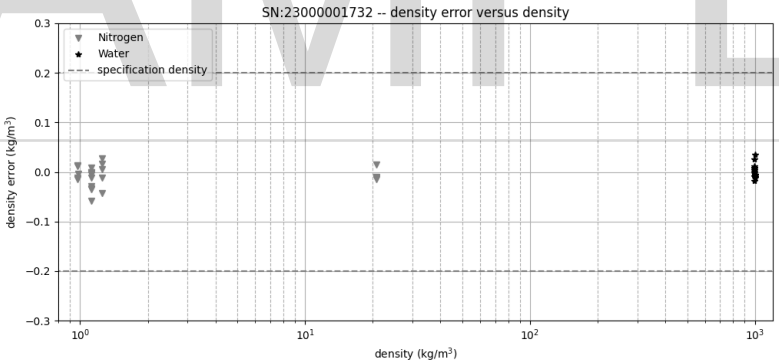
6243	VLO-M2-nonEX unpotted	23000001732	TDDCP-03
Cal.Cert.No	Sensor	Serial No	Calibration rig

$C_0 = -2.913\,90$	$C_1 = 2.397\,90 \times 10^{9}$	$C_2 = -1.047\,77 \times 10^{5}$	$C_{22} = -1.908\,47 \times 10^{2}$
Density coefficients			

$C_5 = 9.671\,42 \times 10^{-3}$	$C_7 = 7.669\,35 \times 10^{-7}$	$C_8 = 1.255\,80 \times 10^{-6}$
Density coefficients		

$T_A = -7.385\,04 \times 10^{-12}$	$T_B = 1.408\,57 \times 10^{-4}$	$T_C = -1.295\,21 \times 10^{3}$	$T_D = 2.568\,16 \times 10^{-19}$
Temperature coefficients			

	Reference Data			DUT Data			Error versus Specification (2K)			
Fluid	Press. (bar a)	Temp. (°C)	Density (kg/m³)	Frequency (Hz)	Temp. (°C)	Density[1] (kg/m³)	Temp. (°C)	Spec. (°C)	Density[1] (kg/m³)	Spec. (kg/m³)
					Calibration with adjustment					
nitrogen	18.32	25.01	20.76	28 576.9	25.01	20.76	0.00	0.15	−0.00	0.20
nitrogen	0.99	25.01	1.12	28 667.5	25.01	1.12	0.00	0.15	−0.00	0.20
nitrogen	0.99	−4.80	1.25	28 682.9	−4.80	1.25	0.00	0.22	−0.00	0.30
nitrogen	0.99	69.68	0.98	28 640.3	69.68	0.98	0.00	0.34	−0.00	0.45
water	0.97	25.07	997.03	24 749.1	25.07	997.02	0.00	0.15	−0.01	0.20
water	18.23	25.03	997.82	24 750.3	25.03	997.83	0.00	0.15	0.01	0.20
					Calibration without adjustment					
water	0.96	25.02	997.04	24 749.0	25.02	997.04	0.00	0.15	0.00	0.20
nitrogen	0.99	25.01	1.12	28 667.6	25.01	1.09	0.00	0.15	−0.03	0.20



Calibration method and metrological traceability: Deionized water (thermal conductivity $<5 \times 10^{-1}$ µS/cm and specific gravity < 1.00001) and nitrogen purity 5.0 ($N_2 \geq 99.5\%$, $O_2 + Ar \leq 0.5\%$ and $Ar < 0.1\%$) are used for calibration. An unbroken chain of calibrations going back to international standards is established for the temperature and pressure reference sensors according to ISO 17025.

	Expanded measurement uncertainty of reference:	Specification sensor:
Pressure (bar)	$\pm < 0.02$	none
Temperature (°C)	$\pm < 0.05$	± 0.15 or $[0.0075 \times \lvert T - 25\,°C \rvert]$ if the value is > 0.15
Density (kg/m³)	$\pm < 0.10$	± 0.20 or $[0.01 \times \lvert T - 25\,°C \rvert\ ]$ if the value is > 0.20

[1] Note: Density measurement of the density sensor depends on pressure. If the actual measuring pressure is known, the pressure effect can be compensated. The listed calibration data shows measuring performance with active pressure compensation. By default, the pressure compensation is set to a fixed pressure, typically 1 bar (absolute). If the actual measuring pressure is higher than the fixed compensation pressure, the density sensor shows a density that is too low. For detailed information concerning specifications and pressure compensation, see the product documentation.

25.01.2024	09:16	C.Huber	
Date	Time	Calibrated by	Signature

TrueDyne Sensors AG • Christoph-Merian-Ring 20 • CH-4153 Reinach
T +41 61 715 89 00 • info@truedyne.com • www.truedyne.com

Calibration certificate

Viscosity calibration

6243	VLO-M2-nonEX unpotted	23000001732	TDVCP-01
Cal.Cert.No	Sensor	Serial No	Calibration rig

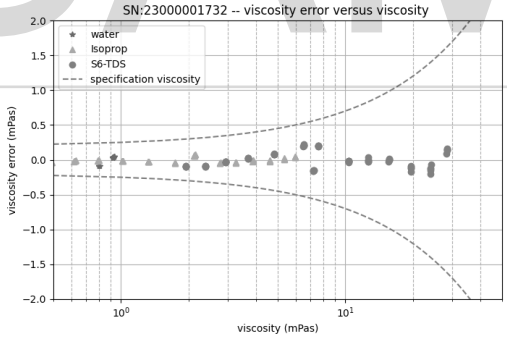
$D_0 = 1.142\,34 \times 10^{-3}$ $D_1 = 5.126\,50 \times 10^{-3}$ $D_2 = 4.108\,61 \times 10^{-6}$

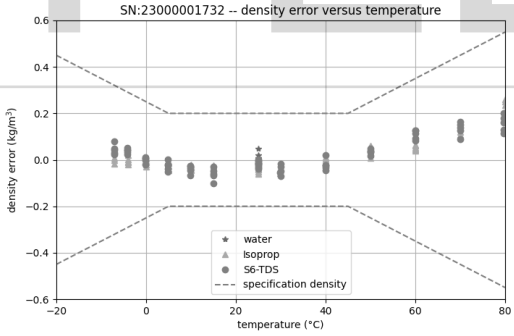
Damping coefficients

$A_0 = 4.596\,93 \times 10^{1}$ $A_1 = 6.128\,00 \times 10^{8}$ $A_2 = 0.0$ $A_3 = 4.20 \times 10^{-1}$

Viscosity coefficients

	Reference Data				DUT Data					Error versus Specification (2K)					
Fluid	Press. (bar a)	Temp. (°C)	Viscosity (mPa s)	Density (kg/m^3)	Frequency (Hz)	Damping	Temp. (°C)	Viscosity (mPa s)	Density (kg/m^3)	Temp. (°C)	Spec.[2] (°C)	Viscosity (mPa s)	Spec.[2] (mPa s)	Density (kg/m^3)	Spec.[2] (kg/m^3)
water	0.97	25.07	0.89	997.03	24 749.1	86.8	25.07	0.93	997.02	0.00	0.15	0.04	0.24	−0.01	0.20
water	18.23	25.03	0.89	997.82	24 750.3	84.5	25.03	0.80	997.83	0.00	0.15	−0.09	0.24	0.01	0.20
water	0.96	25.02	0.89	997.04	24 749.0	86.7	25.02	0.92	997.04	0.00	0.15	0.04	0.24	0.00	0.20
Isoprop	1.20	24.95	2.07	781.20	25 461.5	146.2	24.93	2.14	781.15	−0.02	0.15	0.07	0.30	−0.04	0.20
Isoprop	1.20	14.90	2.80	789.52	25 437.9	145.9	14.94	2.76	789.48	0.04	0.15	−0.05	0.34	−0.04	0.20
Isoprop	1.20	9.91	3.29	793.60	25 426.3	147.5	9.94	3.25	793.57	0.03	0.15	−0.04	0.36	−0.03	0.20
Isoprop	1.20	4.91	3.89	797.65	25 414.8	149.7	4.92	3.87	797.62	0.01	0.15	−0.01	0.39	−0.03	0.20
Isoprop	1.20	−0.11	4.62	801.64	25 403.3	151.8	−0.07	4.61	801.63	0.04	0.19	−0.01	0.43	−0.01	0.25
Isoprop	1.20	−4.14	5.32	804.83	25 394.2	153.9	−4.09	5.34	804.83	0.06	0.22	0.01	0.47	−0.00	0.29
Isoprop	1.20	−7.14	5.93	807.20	25 387.3	155.5	−7.08	5.97	807.22	0.05	0.24	0.04	0.50	0.01	0.32
Isoprop	1.20	29.94	1.79	776.96	25 473.6	142.9	29.91	1.74	776.91	−0.03	0.15	−0.04	0.29	−0.05	0.20
Isoprop	1.20	39.96	1.35	768.15	25 498.5	142.6	39.94	1.32	768.15	−0.02	0.15	−0.03	0.27	−0.00	0.20
Isoprop	1.20	49.96	1.03	758.99	25 524.6	143.0	49.93	1.02	759.02	−0.03	0.19	−0.02	0.25	0.03	0.25
Isoprop	1.20	59.97	0.80	749.35	25 552.2	144.4	59.95	0.79	749.40	−0.01	0.26	−0.01	0.24	0.05	0.35
Isoprop	1.20	69.95	0.64	739.20	25 581.4	146.4	69.95	0.62	739.33	−0.00	0.34	−0.02	0.23	0.13	0.45
Isoprop	1.20	79.93	0.53	728.45	25 612.4	149.0	79.95	0.49	728.68	0.02	0.41	−0.04	0.23	0.23	0.55
Isoprop	1.20	24.95	2.07	781.18	25 461.5	146.0	24.95	2.12	781.15	0.00	0.15	0.06	0.30	−0.03	0.20
S6-TDS	1.20	24.93	7.37	830.67	25 291.7	194.5	24.94	7.57	830.65	0.01	0.15	0.20	0.57	−0.02	0.20
S6-TDS	1.20	14.94	10.40	837.36	25 274.1	199.4	14.94	10.37	837.30	0.00	0.15	−0.02	0.72	−0.06	0.20
S6-TDS	1.20	9.92	12.65	840.73	25 264.9	204.2	9.91	12.64	840.69	−0.01	0.15	−0.00	0.83	−0.04	0.20
S6-TDS	1.20	4.93	15.65	844.09	25 255.8	209.6	4.89	15.65	844.06	−0.03	0.15	−0.00	0.98	−0.03	0.20
S6-TDS	1.20	−0.08	19.76	847.46	25 246.4	215.2	−0.14	19.64	847.46	−0.06	0.19	−0.12	1.19	0.00	0.25
S6-TDS	1.20	−4.11	24.16	850.15	25 238.8	219.9	−4.15	24.03	850.19	−0.04	0.22	−0.13	1.41	0.04	0.29
S6-TDS	1.20	−7.08	28.21	852.14	25 233.2	223.5	−7.14	28.35	852.19	−0.06	0.24	0.14	1.61	0.04	0.32
S6-TDS	1.20	29.94	6.31	827.33	25 300.6	192.3	29.92	6.52	827.29	−0.02	0.15	0.21	0.52	−0.04	0.20
S6-TDS	1.20	39.96	4.73	820.61	25 318.0	187.5	39.97	4.81	820.59	0.01	0.15	0.08	0.44	−0.02	0.20
S6-TDS	1.20	49.97	3.66	813.89	25 335.2	184.8	50.00	3.68	813.92	0.03	0.19	0.02	0.38	0.04	0.25
S6-TDS	1.20	59.97	2.96	807.20	25 351.9	184.3	59.99	2.93	807.31	0.03	0.26	−0.03	0.35	0.11	0.35
S6-TDS	1.20	69.95	2.47	800.52	25 368.7	185.1	69.97	2.37	800.65	0.02	0.34	−0.09	0.32	0.13	0.45
S6-TDS	1.20	79.67	2.04	794.05	25 384.8	186.0	79.63	1.95	794.20	−0.03	0.41	−0.09	0.30	0.16	0.55
S6-TDS	1.20	24.94	7.37	830.65	25 291.8	191.3	24.97	7.22	830.64	0.03	0.15	−0.15	0.57	−0.01	0.20





Calibration method and metrological traceability: Traceable Standard Reference Materials (SRM) or reference standards calibrated with certified measurement equipment are used for viscosity calibration.

	Expanded measurement uncertainty of reference:	Specification sensor:
Viscosity (mPa s)	$\pm < 0.5\%$ of MV	$\pm\,[5\%$ of MV $+ 0.2]$
Temperature (°C)	$\pm < 0.05$	± 0.15 or $[0.0075 \times \lvert T - 25\,°\text{C}\rvert]$ if the value is > 0.15
Density (kg/m^3)	$\pm < 0.10$	± 0.20 or $[0.01 \times \lvert T - 25\,°\text{C}\rvert\ ]$ if the value is > 0.20

[2] Note: Specification = max permissible error: Includes specification of sensor and expanded measurements uncertainty of reference.

12.02.2024	10:02	C.Huber	
Date	Time	Calibrated by	Signature

TrueDyne Sensors AG • Christoph-Merian-Ring 20 • CH-4153 Reinach
T +41 61 715 89 00 • info@truedyne.com • www.truedyne.com